1127

PCT/ZA 2004/000079

06 OCT 2004

Sertifikaat

REPUBLIEK VAN SUID AFRIKA

PATENT KANTOOR
DEdepartement VAN HANDEL
EN NYWERHEID

Certificate

REPUBLIC OF SOUTH AFRICA

PATENT OFFICE
DEPARTMENT OF TRADE AND
INDUSTRY

Hiermee word gesertifiseer dat
This is to certify that

PCT/ZA 2004/000079

06 OCT 2004

REC'D 20 OCT 2004
WIPO PCT

the documents annexed hereto are true copies of:

Application forms P.1, P2, provisional specification and drawing of South African Patent Application No. 2003/5560 as originally filed in the Republic of South Africa on 18 July 2003 in the name of DETNET SOLUTIONS (PTY) LTD for invention entitled: "BLAST SEQUENCE CONTROL."

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN
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Geteken te **PRETORIA** in die Republiek van Suid-Afrika, hierdie **16th** dag van **September 2004**

Signed at **PRETORIA** in the Republic of South Africa, this **16th** day of **September 2004**

.....
Registrar of Patents

McCALLUM, RADEMEYER & FREIMOND
Ref: P.19967

REVENUE INKOMSTE 18.7.03

REPUBLIEK VAN SUID-AFRIKA
REVENUE R 006000 INKOMSTE
FORM P
FTR 074
REPUBLIC OF SOUTH-AFRICA

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT

(Section 30(1) – Regulation 22)

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

Revenue Stamps or Revenue Franking Machine Impression
OFFICIAL DATE STAMP

OFFICIAL APPLICATION NO.

21	01	2003/5560

FULL NAME(S) OF APPLICANT(S)

71	DETNET SOLUTIONS (PTY) LTD

ADDRESS(ES) OF APPLICANT(S)

AECI Place, The Woodlands, Woodlands Drive, Woodmeand, Sandton

TITLE OF INVENTION

54	BLAST SEQUENCE CONTROL

Priority is claimed as set out on the accompanying Form P2.

The earliest priority claimed is: **NONE**

This application is a patent of addition to Patent Application No.	21	01	

This application is a fresh application in terms of section 37 and based on Application No.	21	01	

THIS APPLICATION IS ACCOMPANIED BY:

- ☒ 1 A single copy of a provisional specification of ...12... pages
- ☐ 2 Two copies of a complete specification of ..... pages
- ☒ 3 ...4 ... Sheets of Informal Drawings
- ☐ 4 ..... Sheets of Formal Drawings
- ☐ 5 Publication particulars and abstract (Form P8 in duplicate)
- ☐ 6 A copy of Figure ..... of drawings (if any) for the abstract
- ☐ 7 Assignment of Invention
- ☐ 8 Certified priority document(s) Number(s)
- ☐ 9 Translation of priority document(s)
- ☐ 10 An assignment of priority rights
- ☐ 11 A copy of the Form P2 and the specification of SA Patent Application
- ☐ 12 A declaration and power of attorney on Form P3
- ☐ 13 Request for ante-dating on Form P4
- ☐ 14 Request for classification on Form P9
- ☒ 15 Form P2 in duplicate

21	01	

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Dated 18 July 2003

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McCALLUM, RADEMEYER & FREIMOND
PATENT AGENTS FOR APPLICANT(S)

Received: Official Date Stamp
REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
2003 -07- 18
REGISTRAR OF PATENTS
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

FORM P2

MRF Ref:P.19967

REPUBLIC OF SOUTH AFRICA — **PATENTS ACT, 1978**

REGISTRAR OF PATENTS

Official Application No.	Lodging date: Provisional	Acceptance date:
21 01 2003/5560	22 18 July 2003	47
International classification	**Lodging date: Complete**	**Granted date:**
51	23	

Full name(s) of applicant(s)/Patentee(s)

71 DETNET SOLUTIONS (PTY) LTD

Applicant(s) substituted: AANSOEKERS VERVANG	Date Registered:
71 Detnet South Africa (Pty) Limited APPLICANTS SUBSTITUTED	01.07.04

Assignee(s):	Date Registered:
71	

Full name(s) of inventor(s)

72 KOEKEMOER, Andre Louis and LABUSCHAGNE, Albertus Abraham

Priority claimed	Country	Number	Date
Note: Use International Abbreviation for Country	33 NONE	31 NONE	32 NONE
	33	31	32
	33	31	32

Title of Invention:

54 BLAST SEQUENCE CONTROL

Address of applicant(s)/patentee(s)

AECI Place, The Woodlands, Woodlands Drive, Woodmeand, Sandton

Address for Service:

74 **McCALLUM, RADEMEYER & FREIMOND, Maclyn House, 7 June Avenue, Bordeaux, Randburg • P.O. Box 1130, Randburg 2125**

Patent of Addition to Patent No.:	Date of any change:	
61		
Fresh Application based on:	Date of any change:	

McCALLUM, RADEMEYER & FREIMOND
Ref: P.19967

FORM P6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) – Regulation 27)

OFFICIAL APPLICATION NO		LODGING DATE	
21	01 2003/5560	22	18 July 2003

FULL NAME(S) OF APPLICANT(S)

71	DETNET SOLUTIONS (PTY) LTD

FULL NAME(S) OF INVENTOR(S)

72	KOEKEMOER, Andre Louis and LABUSCHAGNE, Albertus Abraham

TITLE OF INVENTION

54	BLAST SEQUENCE CONTROL

BACKGROUND OF THE INVENTION

[0001] This invention relates to a blasting system and to a method of controlling the blasting or initiation of a plurality of detonators in a blasting system.

[0002] Detonators are often connected to one another in a predetermined sequence and programmed so that each detonator is initiated at a predetermined time relatively to other detonators in the sequence. Preset time differences may prevail between adjacent detonators in the sequence but this time difference can be dependent on the geographical pattern in which the detonators are positioned or the nature of the rock in which the detonators are placed. More generally it can be said that the timing sequence is influenced by the environment of the detonators. For example in an underground situation a particular blasting pattern may apply in respect of detonators which are in a stope as opposed to detonators which are in a gully.

SUMMARY OF INVENTION

[0003] The invention provides, in the first instance, a method of controlling initiation of a plurality of detonators connected in a predetermined sequence which includes the step of marking at least one location in the sequence at which detonators in the sequence after the location are initiated differently from detonators in the sequence before the location.

[0004] The sequence of detonators may extend over at least two zones in which different types of blasting control are to be exercised. The nature of the blasting control may be influenced by different factors such as the detonator deployment direction, physical conditions in which the detonators are used and the rock types in which the detonators are placed. Thus the detonators in each zone are initiated in a manner which takes account of the characteristics in, and the requirements of, that zone.

[0005] Each zone may be demarcated, in the blasting sequence, by marking at least two locations which are spaced from each other in the sequence of detonators.

[0006] The detonator sequence may be configured so that the zones follow one another successively in a geographical sense or so that at least one zone extends, in the form of a branch line of detonators, from a main line of detonators.

[0007] In a variation of the invention the marked location designates a transition in the detonator sequence wherein detonators after the location are arranged in two or more zones which extend, from the location, independently of each other.

[0008] The invention also extends to a blast marker which includes a controller, a memory in which blast information or a pointer to blast information is stored, an input to, and an output from, the controller, and connectors for connecting the input and output to a blasting harness whereby,

upon receipt of an enabling signal via the harness at the input, the blast information or the pointer is made available on the harness, by the output, to control the initiation of at least one detonator.

[0009] The pointer may be a code which is associated with and which specifies particular blast information or it may designate an address at which the required blast information is to be accessed.

[0010] The invention also extends to a blasting system which includes a plurality of detonators connected in a predetermined sequence and a blast marker, at a defined location in the sequence, which causes detonators in the sequence, after the location, to be initiated differently from detonators in the sequence before the location.

[0011] The blast marker may be a blast marker of the aforementioned kind.

[0012] The blasting system may include at least two blast markers which respectively define opposed boundaries, in a blasting sense, of a zone. Adjacent zones may be separated from each other, in a blasting sense, by respective blast markers.

[0013] The blasting system may be configured in a variety of ways, according to requirement, and the invention is not limited in this regard. In one example of the invention the blasting system is configured in the form of a main line of detonators with at least one branch line of detonators which extends from the main line of detonators.

[0014] In a different form of the invention the blasting system is configured so that the detonators extend from a blast marker in a plurality of lines which are parallel to each other and with each line of detonators extending over a defined zone.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention is further described by way of examples with reference to the accompanying drawings in which:

Figure 1 is a schematic representation of a blasting system according to the invention in a first configuration;

Figure 2 illustrates a blast marker which is suitable for use in the blasting system of the invention;

Figure 3 illustrates a blasting system, according to the invention, in a different configuration from what is shown in Figure 1;

Figure 4 shows the configuration of Figure 4 in a modified layout;

Figure 5 depicts a blast marker, according to the invention, which is different from what is shown in Figure 2; and

Figures 6 and 7 are respectively geographical and electrical representations of a blasting system according to the invention in what is referred to herein as a "hub" configuration.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] Figure 1 of the accompanying drawings illustrates a blasting system 10 according to the invention which includes a blasting bus or harness 12 to which are sequentially connected a plurality of detonators 14A, 14B ... 14N.

[0017] The detonators are grouped in zones 16A, 16B ... 16N. In this instance the detonators 14A to 14D are in zone 16A, the detonators 14E to 14G are in zone 16B, and so on. Each zone is represented, purely for ease of reference, by a rectangular block. In practice each zone is defined or formed by the characteristics of the environment in which blasting is to take place. For example the zone 16A may have hard rock while the zone 16B may have a softer rock. Another possibility is that one zone may be located in a gully or a relatively large underground excavation while an adjacent zone may be located in a stope or a relatively restricted or confined underground excavation. These examples are merely illustrative and are not limiting. In general it can be said that the blasting requirement, typically as embodied in the time delays attributed to the individual detonators in a particular zone, is different from the blasting requirement in an adjacent zone.

[0018] Each boundary or transition location 20 between adjacent zones is marked by a blast marker 22. In Figure 1 a boundary location 20A is formed between the zones 16A and 16B and is marked by a blast marker 22A. The boundary location 20B between the second and third zones is marked by a blast marker 22B, and so on down the sequence of detonators.

[0019] The blasting harness 12 extends to a blast controller 30 of known construction. The blast controller is used to give firing signals to the individual detonators and to provide electrical energy to the detonators which enables initiation of the detonators to take place under controlled conditions. The blast direction is designated by an arrow 34 and takes place in a direction along the harness 12 which extends away from the blast controller 30.

[0020] Figure 2 illustrates a blast marker 22 which includes a standard detonator case or housing 40 in which are mounted a standard detonator control circuit or chip 42 and a capacitor 44 which is used to provide energy to the chip 42. The chip and capacitor are mounted on a substrate such as a printed circuit board 46. The chip includes at least a control or logic unit 48 and an identity register 49 which is part of non-volatile memory of the chip 42.

[0021] The blast marker has inputs 50A, 50B and 50C respectively and an output 52. The inputs 50 and the outputs 52 are connected to the harness 12 using a standard connector 56.

[0022] The various electrical components are encapsulated in the housing 40 using any suitable technique eg. a standard potting compound.

[0023] The type of connector 56, although standard, is chosen so that it is compatible with connectors, not shown, which are used to connect the detonators 14 (shown in Figure 1) to the harness 12.

[0024] Blasting information, which is particular to the detonators in a given zone 16, is loaded into the memory of the blast marker 22 which precedes the zone. This blast information is determined taking into account the character and requirements of the following zone. Thus, referring to Figure 1, the blast controller 30 is loaded with the information which determines the timing delays associated with the detonators in the zone 16A; the blast marker 22A has timing information which must be attributed to the detonators in the zone 16B and so on through the succession of zones in the blast direction 34.

[0025] In a different technique an address or code, referred to as a pointer, which relates to blast information eg. a location at which blast information can be accessed, is loaded into the memory in the marker. When the blast sequence programming operation reaches the marker the pointer designates a location at which the blast information is to be accessed via the communications bus and that information is used in the following zone.

[0026] Each marker is uniquely identified by identity data in the respective register 49. Thus, in a given blasting configuration, the markers are used at each boundary location 20 to demarcate an end or exit point of one zone from a beginning or entering point of an adjacent zone. This allows the blast system to take the required action in programming the detonators in the sequence to cater for the specific needs or changes in blasting character in any blasting installation.

[0027] The user of a blasting system is therefore able with ease to install a complex blast pattern in a sequence where the character or deviation from the standard sequential installation requires timing changes.

[0028] Figure 3 illustrates a blasting system 60 which is based on a modification of what has been described hereinbefore. Components shown in Figure 3 which are similar to components already described bear like reference numerals and are not further described herein.

[0029] The blasting system 60 is suited for use under conditions where a zone 16P which includes a plurality of detonators 14A to 14E and 14J to 14N needs to be interrupted to serve an anomalous zone 16R without exerting a major influence on the standard blasting routine which is required for the detonators in the zone 16P.

[0030] The zone 16R includes detonators marked 14F to 14I which are directly connected to the wiring harness 12. The location 20P at which the zone 16R borders the first portion of the zone 16P is the same, in an electrical sense, as the location at which the zone 16R borders the remaining detonators in the zone 16P. The commencement of the zone 16R is designated by a marker 22K while a blast marker 22L marks the end of the zone 16R. The marker 22K is referred to herein as an exit marker while the marker 22L is referred to herein as a return marker.

[0031] It is evident that the marker 22K is used to impart predetermined timing information to the detonators in the zone 16R while the marker 22L is

used to ensure that the detonators 14J to 14N have the same timing information as the detonators 14A to 14E which precede the zone 16R.

[0032] The blasting system shown in Figure 3 can be implemented, using the principles of the invention, in an alternative manner which is shown in Figure 4. Again, where applicable, like components are designated by like reference numerals and are not described in detail.

[0033] The detonators 14F to 14I in the zone 16R are separated from the remaining detonators by a blast marker 22S which is referred to herein as a splitter and which combines the functions of the exit marker 22K and the return marker 22L shown in Figure 3.

[0034] The splitter 22S is shown in Figure 5 and includes a housing 60 which accommodates a device 62 which is equivalent to the exit marker and a device 64 which is equivalent to the return marker. The blast harness 12 includes an input line 65 which goes to the device 62 and which, in use, carries an enabling signal which actuates the device 62 so that the timing information which is prestored in the device is imparted to the detonators 14F to 14I in the zone 16R following the splitter 22S. A return line 66 from the zone 16R goes to the device 64 and functions in the way similar to what has been described in that an enabling signal on the line 65 causes timing information to be imparted to the detonators 14J to 14N which is the same as the timing information in loaded into the detonators 14A to 14E. Communications lines 68 and 70 in the harness 12 are connected in parallel to the detonators in the zones 16P and 16R.

[0035] It is evident that the incoming harness 12 is split into two serviceable outputs namely a branch line 12A and a continuation of the main line, designated 12B, from which the branch line extends.

[0036] The splitting concept can be used for multiple branch splitting by connecting and assigning a number of exit markers in a sequence. Each exit marker is then an identifier for each branch which exits the splitter. Each branch can then be dealt with as a separate zone similar to what has been described hereinbefore.

[0037] Figures 6 and 7 illustrate a further variation of the aforementioned principle. In this case a zone or blast marker 22Z is used in a daisy chain hub. Figure 6 is a geographical representation of a desired blasting layout while Figure 7 is an electrical representation of the blasting system. The hub is connected via a blast harness 12 to a suitable blast controller 30.

[0038] The layouts shown in Figures 6 and 7 are to be interpreted in conjunction and one particularly suitable for use in generating a blasting pattern for sinking a circular shaft. Figure 6 illustrate 6 zones designated 80A to 80F respectively, each of which is sector-shaped, arranged around the hub 22Z to form a composite circular shape. The detonators 14 which are employed in each of the zones are sequentially connected to one another as is indicated in the electrical representation shown in Figure 7. Each zone 80 can be individually programmed with predetermined blast delays or a particular program developed for one zone can be repeated and then stepped to another zone at a defined offset in time.

Dated this 18th day of July 2003.

McCALLUM, RADEMEYER & FREIMOND
Patent Agents for the Applicant

P.19967/jes
Your Ref: DETN005

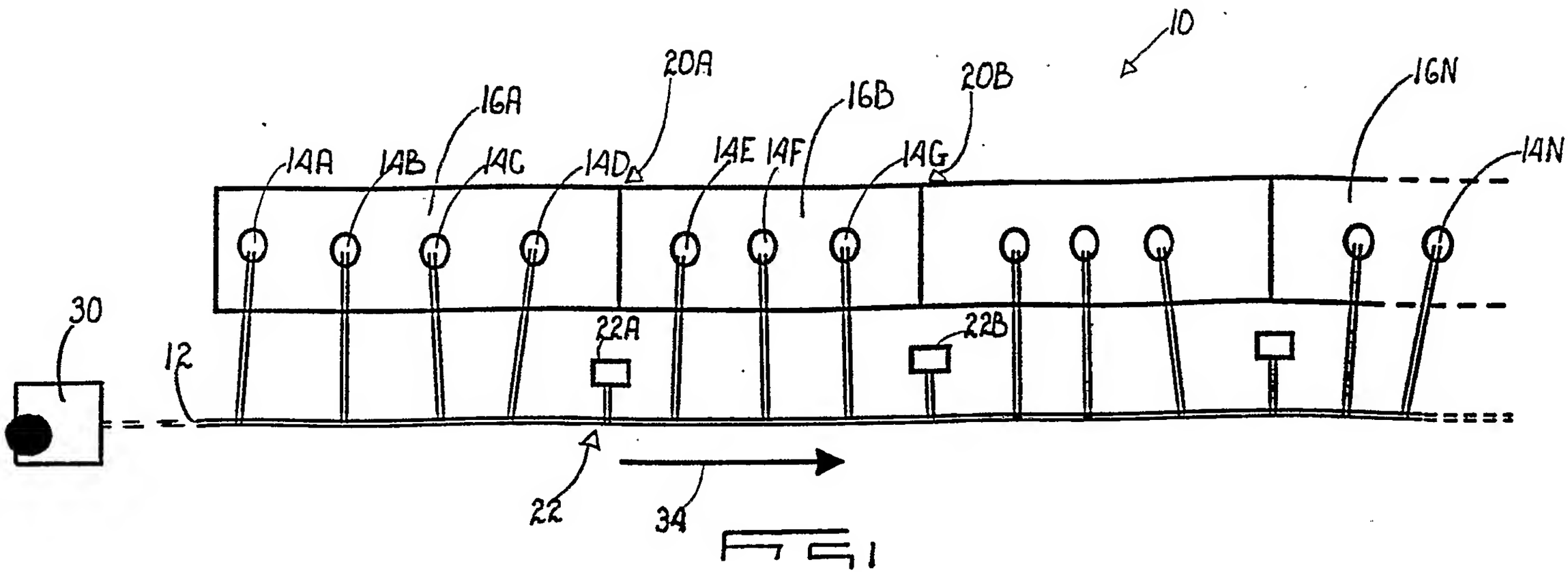

FIG 1

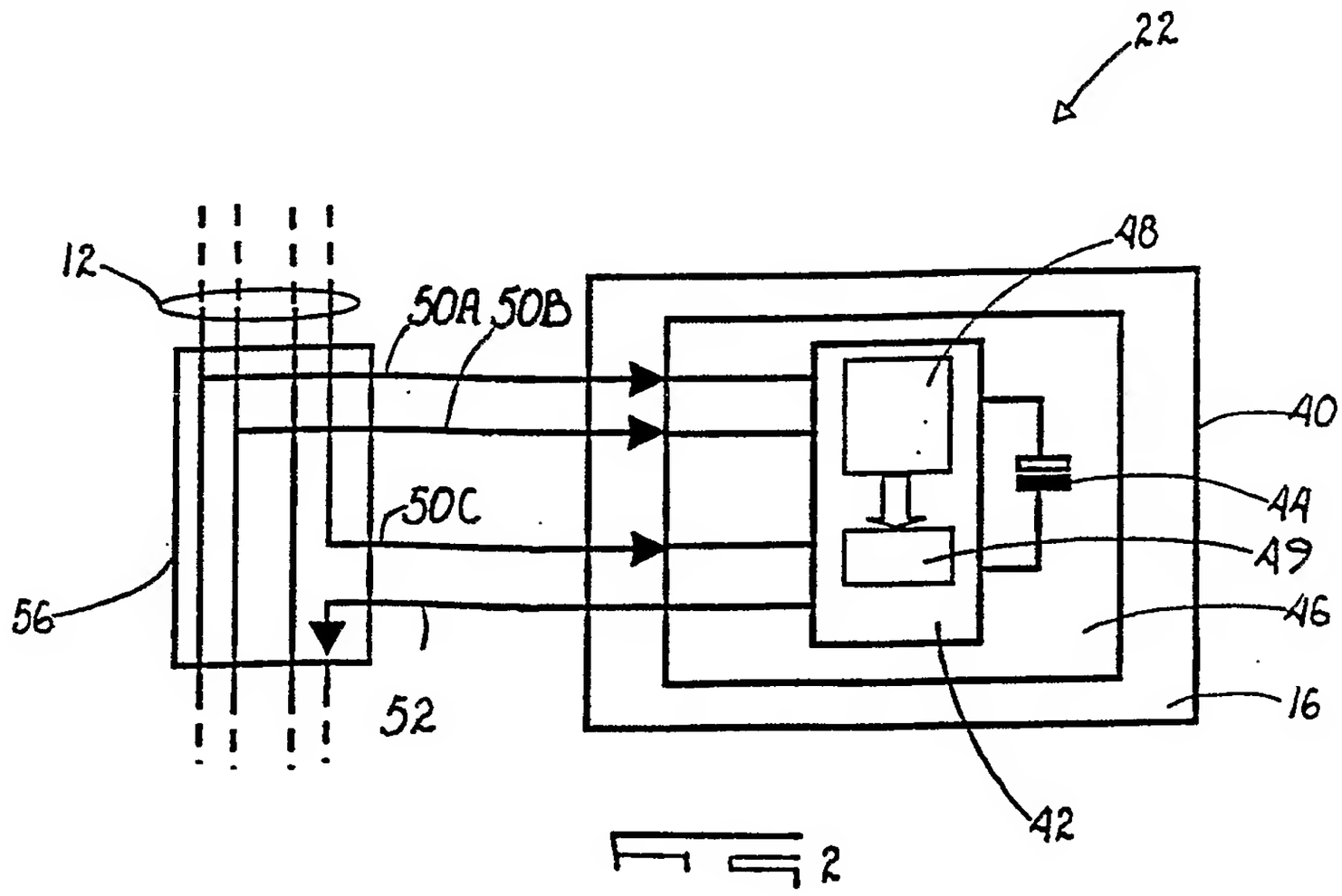

FIG 2

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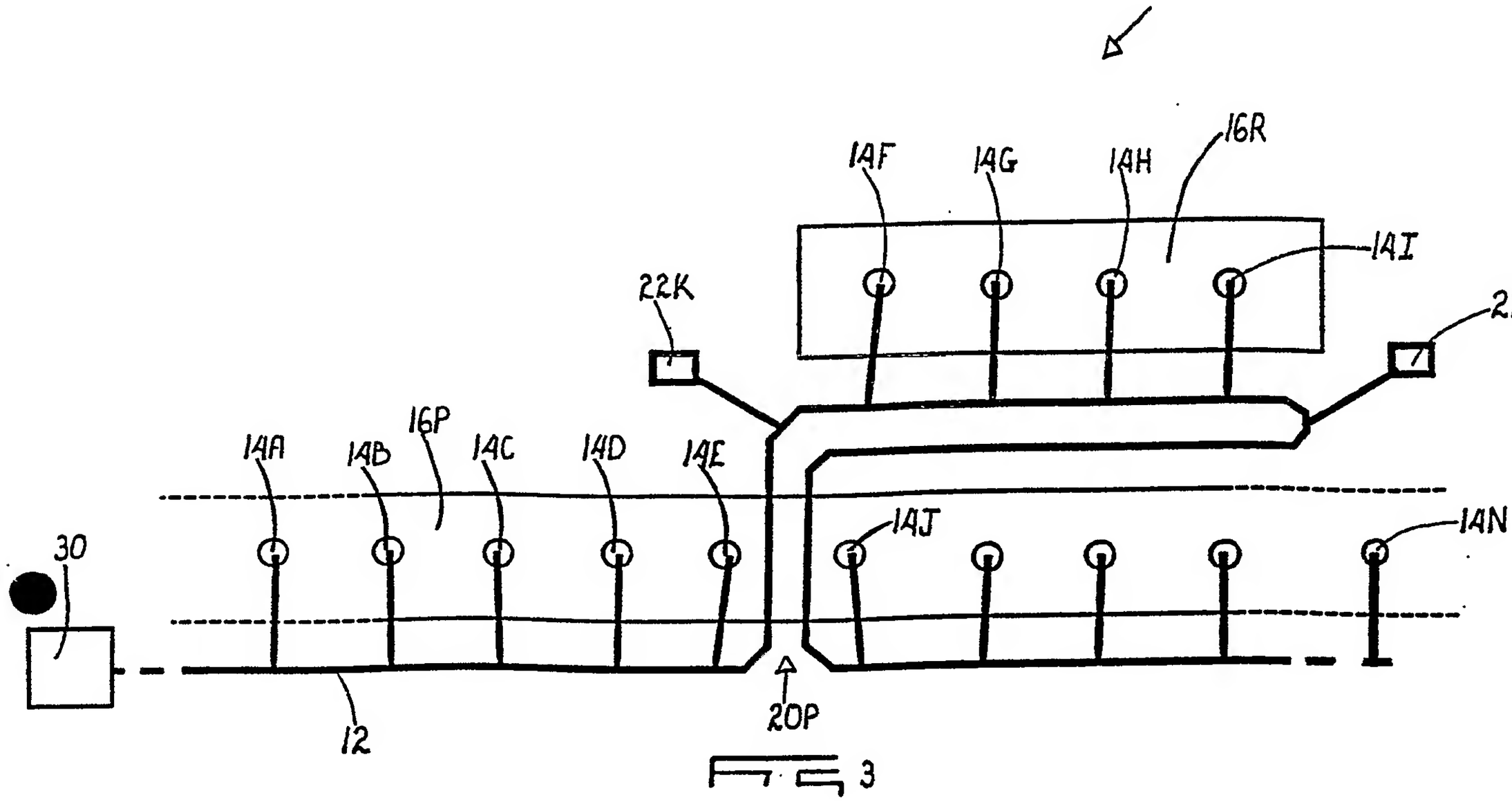

FIG 3

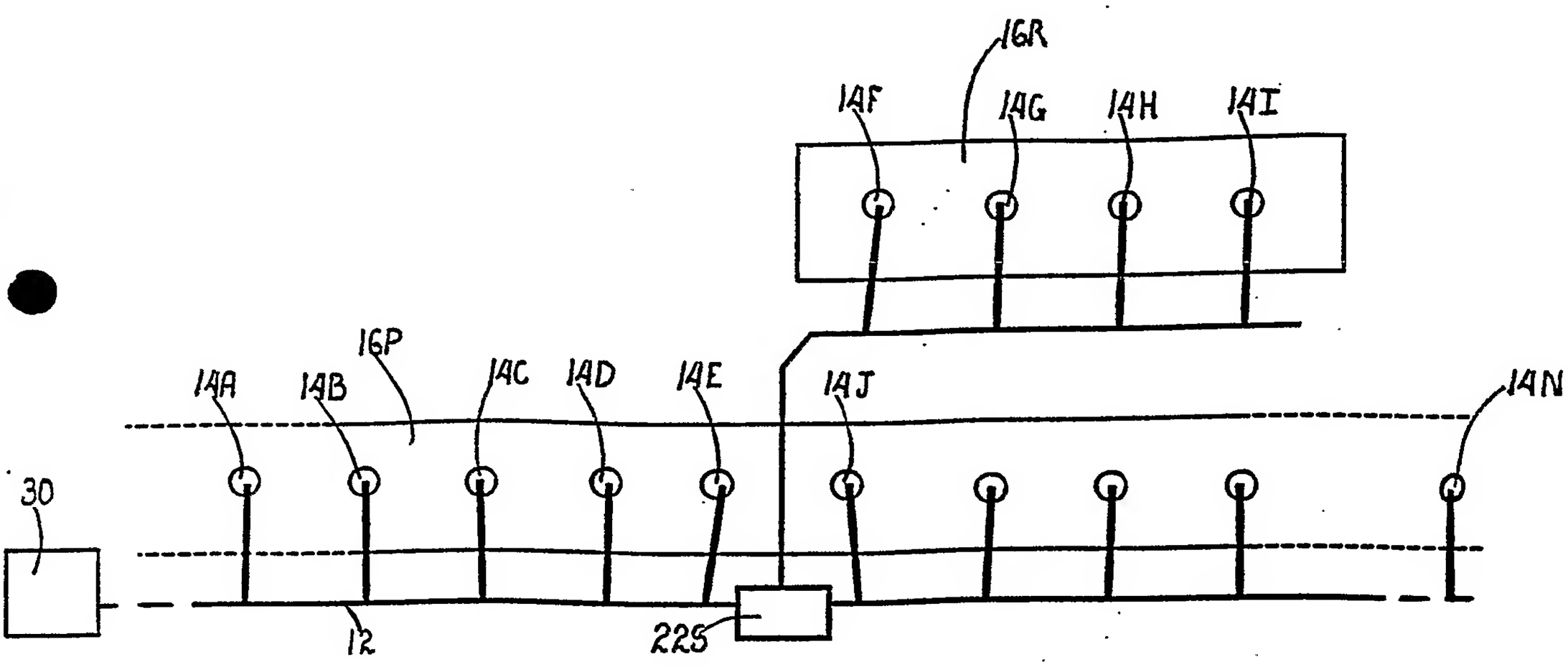

FIG 4

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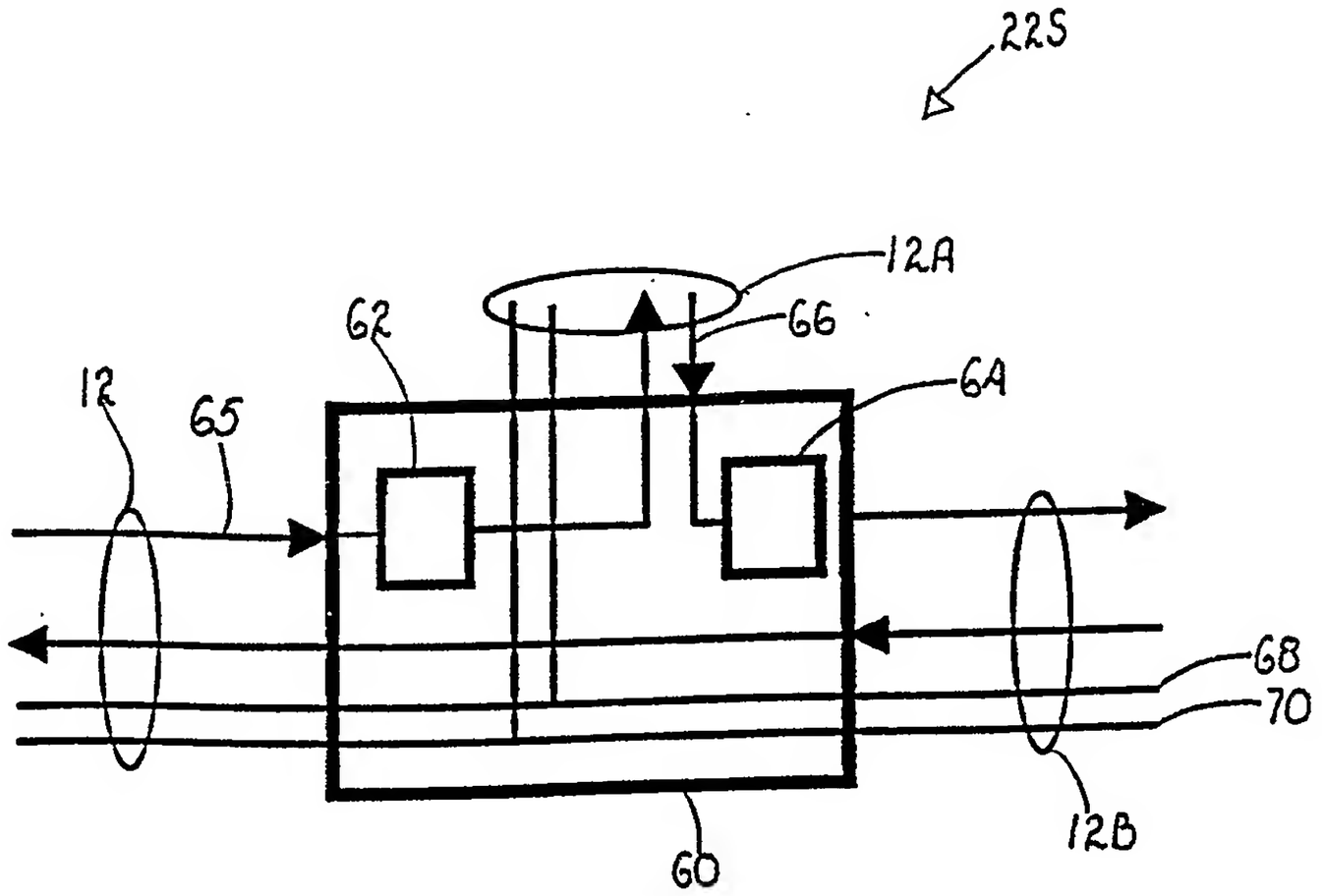

FIG 5

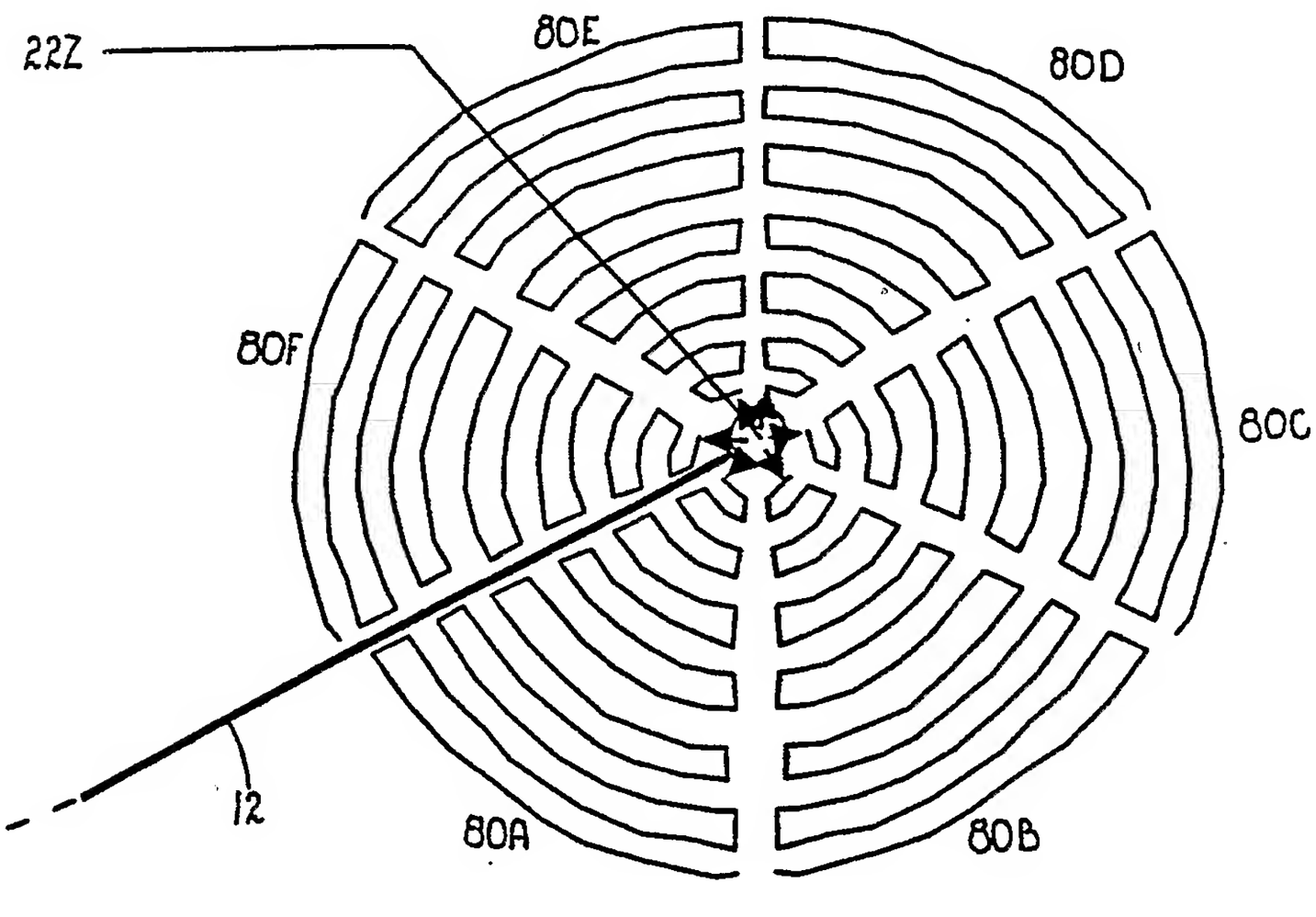

FIG 6

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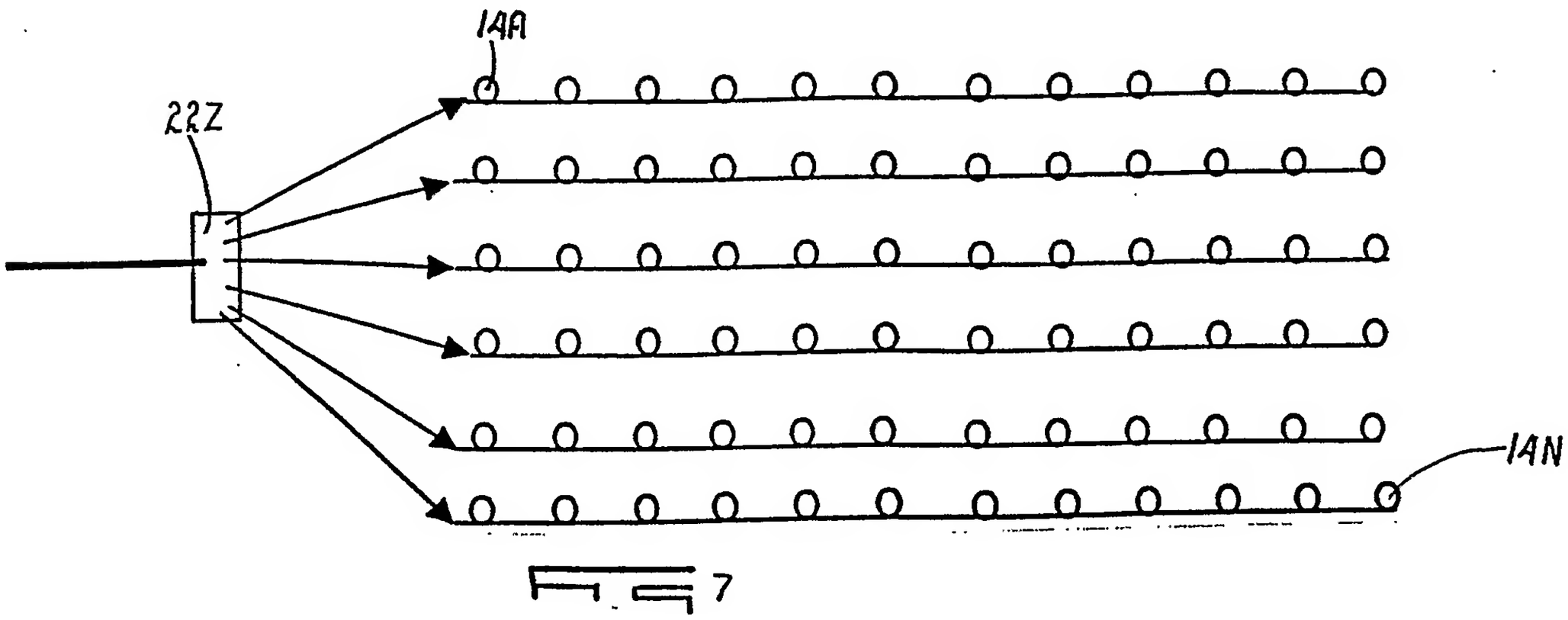

FIG 7

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